UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/882,323	06/13/2001	Ajay Kumar	002772 USA P 01/ETCH/SILI	8716

32588 7590 01/23/2004

APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

EXAMINER	
OLSEN, ALLAN W	
ART UNIT	**PAPER NUMBER**
1763	

DATE MAILED: 01/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/882,323	KUMAR ET AL.
	Examiner	Art Unit
	Allan W Olsen	1763

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 June 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-87* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-87* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-28, 57-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,721,090 issued to Okamoto et al. (hereinafter, Okamoto) in view of US patent 5,910,392 issued to Nozaki et al. (hereinafter, Nozaki).

Okamoto teaches plasma etching silicon nitride through a patterned photoresist using a fluorocarbon, for example CF_4, as the etchant. Okamoto teaches that the fluorocarbon should be used in combination with one or more additives. The additives include SO_2, SF_6, NF_3 and Ar. Okamoto teaches that CF_4 should comprise more than 50% of the etchant mixture (col. 3, lines 44-50). Additionally, at column 10, line 65 – column 11, line 23, Okamoto discloses an embodiment using a fluorine gas: oxygen gas ratio of about 8:1. Therefore, the percentage of fluorine gas in a (CF_4 / SO_2) mixture

would meet the limitation of claimed ratio between the F- containing gas and SO_2. Okamoto's teaching provides for a (CF_4 / SO_2) mixtures with the SO_2 percentage ranging from about 0.1 % to about 49.9 %. The claimed etch rate and selectivity of the instant invention are results that flow from the claimed process. As such, one would be expected to obtain the claimed etched rate and claimed etching selectivity upon carrying out the method of the method of Okamoto.

Okamoto does not explicitly teach changing the amount of SO_2 in the plasma source gas while the nitride layer is being etched. However, Okamoto teaches changing the amount of O_2 while etching silicon nitride and Okamoto teaches that SO_2 can be substituted for O_2. Because Okamoto teaches that O_2 and SO_2 are functional equivalents, and Okamoto teaches changing the amount of O_2, it follows that Okamoto implicitly teaches changing the amount of SO_2 while the nitride layer is being etched.

Okamoto does not teach using an Ar content of 20-60 % in a CF_4 / SO_2/Ar mixture. However, Okamoto teaches CF_4/SO_2/Ar mixture in which CF_4 constitutes more than 50% of the overall mixture. The remaining less than 50 % of the mixture must be divided between SO_2 and Ar but Okamoto does not provide guidance with respect to the relative amounts of SO_2 and Ar. In the absence of explicit guidance, it would be obvious for one skilled in the art to begin the optimization process by using similar amounts of the two additives and in so doing, the skilled artisan would use an etchant consisting of about 20-25 % argon.

Okamoto does not teach using a 1000-2000 Å thick film of a DUV photoresist.

Nozaki teaches using a ≥1000 Å thick film of a DUV photoresist in a manufacturing process for semiconductor devices that have features with a dimension of less than .25 microns. See: abstract; col. 1, lines 1-35; col. 2, lines 48-67, col, 15, line 12.

One skilled in the art would have been motivated to incorporate Nozaki's DUV photoresist into the method of Okamoto because it is well known that using shorter wavelengths in lithographic processes provides for higher resolution. Furthermore, Nozaki teaches a DUV-resist material that, in addition to providing high resolution, has many other advantageous properties such as, high resistance to dry-etching, excellent transparency, and excellent adhesion to substrates.

Claims 29-56 and 68-87 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6,617,257 issued to Ni et al. (hereinafter, Ni) in view of US Published Patent Application 2002/0076935 of Maex et al. (hereinafter, Maex).

Ni teaches etching through organic layers with etchant comprising various mixtures of SO_2, HBr and Ar. See abstract, col 2, lines 28-40; col 8, lines 6-19, 56-65.

Ni does not teach providing a etchant with the claimed F-gas to SO_2 ratio.

Maex teaches etching organic material with an etchant comprising a gas mixture similar to that used by Ni (e.g., $HBr/SO_2/Ar$) to which Maex teaches adding a F-containing gas. Maex teaches optimizing the flow ratios of the etching gases. See abstract and paragraphs [0019] – [0023], [0121].

It would have been obvious to one skilled in the art to add a fluorine-containing gas to the etchant because Maex teaches that this increases the etch rate.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 571-272-1441. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Greg Mills, can be reached on 571-272-1439.

The fax number for TC1700 is 703-872-9306 (non-after finals and after-final).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (571) 272-1300.

Allan Olsen, Ph.D.
January 11, 2004